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Analysis of the Effect of Postharvest Treatments on Some Physical Properties and Moth Infestation of Date Palm Fruit (*Phoenix Dactylifera*)

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Abstract: Date palm fruit are nutritious healthy foods that are consumed fresh and or dried. They are sometimes exported to other states and countries where they are cultivated. This action requires it to be dried and if not properly handled is infected by moths causing postharvest losses and damages. Postharvest treatment such as blanching and drying reduces such losses. Two varieties of date palm fruit medjool and deglet Noor were pretreatment using blanching with plain water and blanching with Nacl at blanching temperature of 0,20,40, 60 and 80 ^{o}C at blanching time of 12 minutes. The samples were dried using direct sun and stored in a hessian bag for 3 months. Physical properties and moth infestation were determined before and after storage period. The results reveal that postharvest treatment has significant effect on the determined parameters. Infestation rate decreased with increase in blanching temperature and even lower for samples treated with blanching and Nacl.

Keywords: *Postharvest Treatment, date Palm, Blanching Temperature, Blanching Time, Moth Infestation.*

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I. INTRODUCTION

Dates are known for their numerous food and industrial uses (Shaghaghian *et al.*, 2014). Thousands of years ago, humans realized their importance, and the inclusion of dates in the diet is currently associated with several positive effects on human physiology (Hussain *et al*., 2020; Khalid *et al*., 2017). Its fruits are known to include an abundant amount of essential nutrients and are considered as a complete food with carbohydrates, fiber, and lipids present in significant amounts. In addition, dates are shown to have a high antioxidant capacity (Biglari *et al.*, 2008; Hussain *et al*., 2020) and diabetes-reducing properties (Mard *et al.*, 2010; Salehi *et al.*, 2019). All of these shows that date fruits are very important for a healthy diet and they contribute to the improvement of human health.

Thousands of date cultivars exist around the world (Chao and Krueger, 2007). It can grow in hot and low humidity areas under any type of soil and is known to be tolerant to saline conditions as compared with many other cultivated plants (Lobo *et al*., 2014). The growth rate and development of date fruit follow a sigmoid growth curve (Chao and Krueger, 2007). The growth of date palm and its shelf life is known to be determined by different environmental factors such as precipitation, birds, wind, insects, microbial attacks, temperature and humidity.

The total production of dates fruit was recorded to be 3.43 million tons in 1990 which was harvested on about 625,000 ha area. Over the past three decades, the demand for global markets has increased reaching 8.52 million tons in 1.092,000 ha. Egypt, Iran, and Saudi Arabia have always been the largest producers of date palm, and a large share of their exports to these countries is allocated (FAOSTAT, 2018).

Physical property of agricultural material is a measurable property which describes a physical state of agricultural material at any given condition and time. Physical properties of agricultural material are those properties that describe or characterize the material under no applied load. Dimensions are very important in the design of sizing, cleaning and grading machines. Bulk density and porosity are major parameters in the design of drying and storage systems (Orhevba et al 2016) also physical specifications of agricultural products constitute the most important parameters needed in the design of grading, transfer, processing and packaging systems

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Date palm fruit is a seasonal plant that is loaded with a lot anti-oxidants and Phyto nutrients consumed by so many people for the purpose of its health benefits. It is easily infested by moth if kept for some period of time, this infestation can lead to a lot of post-harvest waste thereby leading to massive lost in the economy of the farmers and the country at large. It has also been observed that local farmers of date palm fruit dry them on the ground without any treatment, this could also increase the high rate of infestation on the dried date palm fruit. The millennium development of Date palm fruit preservation goals are far from being achieved. Intervention programs have never considered date palm fruit for serious concern. An urgent need to look inward for solutions to problems associated with processing of date palm in Nigeria is necessary. There is need to carry some post-harvest treatments to promote the utilization and consumption of date palm fruit. Hence, the aim of this research to determine effect of post – harvest treatment on some physical properties and moths' infestation of two varieties of Date palm fruit (Medjool and Deglet Noor).

II. MATERIALS AND METHODS

A. Materials

The following materials were used for this research work: Date palm fruit (Medjool & Deglet Noor) 5kg of each variety, Sodium chloride (NaCl) 500g: used for brining solution, 1 table spoon weighing 20g of salt for 1 litre of water, weigh balance of 0.01 g sensitivity accuracy, Hessian bags used for storage. Sieve used to strain out the date palm fruit from blanching water.

B. Pre-Treatment and drying of date palm fruit

The date palm fruit (*Phoenix Dectylifera*) varieties were divided into two groups and each group into five blocks and then pretreated (blanching using plain water and blanching with brine solution at temperature water rising (TWR) (0 °C, 20 °C 40 °C 60 °C and 80 °C) at 12 minutes for each sample. The blanched samples were then dried using direct sun-drying (Abodenyi and Ezeoha 2025) from 8:00am to 5:00pm. The drying process lasted for the period of 27hrs cumulatively. After drying, each sample is stored in Hessian bag and labeled accordingly for a period of 3 months. After these, the effect of pretreatment, drying and storage were analyzed.

C. Experimental Design and Analysis

The effect of the pre-treatment on drying of the date palm fruit was determined using Factorial experimentation in complete randomized design with replications. Two varieties of date palm fruit blanched at five blanching temperatures using two blanching methods.

D. Determination of the Physical Properties

- *Moisture Content*

The moisture content of the fresh date palm fruit was determined before treatment (initial moisture content) and after treatment (final moisture content) of all the treatment. The weight of the empty container was measured and recorded, the total average weight of the sample using a manual weigh balanced, and after treatment and drying is computed and calculated using the given formula (Abodenyi *et al* 2020).

$$\text{M. C}_{(\text{w.b})} = \frac{\text{M}_\text{b} - \text{M}_\text{a}}{\text{M}_\text{b} - \text{M}_\text{c}} \times 100\%$$

Where;

M.C. $_{(w.b)}$ = Moisture Content (Wet basis)

M_b = the weight of moisture can plus sample weight after sun-drying (g).

M_b = Weight of Moisture Can (g)

- *Size*

Date palm fruit Size of Date Palm Fruit; this is the measure of how big or small the Date fruit is. This was determined by measuring the dimension of the principal diameter on three axes- major (a), intermediate (b) and minor (c) before and after sun drying of the two different samples that were randomly selected. Digital vernier caliper with accuracy of ±0.01mm was used to determine these dimensions. The size was calculated using equation (Abodenyi *et al*., 2015).

$$\text{The Size} = (abc)^{1/3}$$

Where,

a = Major diameter

b = intermediate diameter

c = Minor diameter

- *Sphericity*

The sphericity (φ) of Date Palm Fruit; is the measure of how closely the shape of date fruit resembles that of a perfect sphere. This was calculated before/after sun drying of the two different samples by using the following relationship in equation below (Abodenyi *et al*., 2015)

$$\text{The Sphericity is given as } \varphi = \frac{(abc)^{1/3}}{a} \times 100$$

- *Surface Area*

The Surface area of Date Palm Fruit; is the measure of the total area that the surface of the date fruit occupies. This was determined before/after sun drying of the two different samples using equation (Arthur, 2009). The Surface Area (S. A) = π (abc) $^{2}/_{3}$ x Sphericity.

- *Volume*

The Volume of the date palm fruit; this is the amount of space that the date fruit occupies or enclosed within a container. This was determined before and after sun drying of the two different samples using equation as used by Abodenyi, (2016)

$$\text{The volume (V)} = \frac{\pi}{6}(abc)$$

- *Infestation Percentage*

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The infestation percentage of the date palm fruit is the level or state of being invaded or overrun by enzymes, organisms living in a date fruit. This was determined at storage period of three (3) months using the following equation as applied by Abodenyi *et al* 2021.

$$I = \frac{i}{N} \times 100$$

Where,

I = Infestation percentage

N = Total number of counted sample

i = Number of infected samples

Fig 1 Plates A, B, C, D, E and F shows fresh date palm fruit, drying of two varieties of date palm fruit, medjol variety after drying, deglet variety after drying and infestation testing of dried date palm respectively.

III. RESULTS AND DISCUSSIONS

Effect of pretreatment on some physical properties of date palm fruit as shown in table 1 for the two varieties. It was observed from table 1 for Medjool that the major, intermediate and minor diameter decrease from 40.9mm to 1.866mm, from 12mm to 0.811mm and from 5.1mm to 0.443mm respectively before and after sun drying. Similarly, for Deglet Noor the major, intermediate and minor diameter decreased from 22.2mm to 1.246mm, from 6.49mm to 0.639mm and from 1.20mm to 0.428mm respectively before and after sun drying.

For Medjool weight, the size, Sphericity, surface area and volume were also observed from table 1 to decrease as moisture content also decreased from 33.11% to 46.85%, from 1.916mm^2 to 0.0113mm^2, from 1.311m^3 to 3.489 x 10^{-3}m^3 for the Volume. Likewise, for Deglet Noor variety, weight, Sphericity, surface area and volume were also observed from the result with the decrease in moisture content from, 24.97% to 56.339%, from 0.08cm^2 to 8.659 x 10^{-3}cm^2 and from 0.09cm^3 to 1.778 x 10^{-4}cm^3 respectively.

Table 1 Physical Properties of Date Palm Fruit Before and After Sun Drying

Physical properties	**Medjool Before Sun Drying**	**Medjool After Sun drying**	**Deglet Noor Before Sun Drying**	**Deglet Noor After Sun Drying**
Major diameter (mm)	40.9	1.87	22.2	1.246
Intermediate diameter (mm)	12.0	0.81	6.5	0.639
Minor diameter (mm)	3.1	0.44	1.2	0.428
Sphericity (%)	33.11	46.845	24.97	56.33
Surface Area (mm^2)	1.916	0.01127	0.08	8.659 x 10^{-3}
Volume (m^3)	1.311	3.489	0.09	1.778 x 10^{-4}

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E. Effect of pretreatment on Moisture Content and Infestation Percentage of Date Palm Fruit

Moisture content and drying rate were influenced by the intensity of the sunlight and the sample size and date palm fruit (Deglet Noor and medjool) variety. Tables 2 and 4 shows that infestation rate decreased with increase in blanching temperature for the two varieties. The results shown in tables 3, & 5 explains that blanching with NaCl caused a reduction in moisture content of the two varieties which invariably resulted in lower moth infestation rate of the treated samples. Therefore, the best treatment given from the result table 3**,** shows that there is a low level of infestation rate of 6.67% and a moisture content of 10.20% for Deglet Noor using Blanching + NaCl. And in table 5 a lower level of infestation rate of 10% and a moisture content of 4.40% for medjool using same Blanching + NaCl.

Table 2 Treatment of Deglet Noor using Blanching with Plain Water

Temperature level ℃	Weight of Sample Before Sun drying (g)	Weight of Sample After Sun drying (g)	Moisture content of the Sample (%)	Infestation Level (%)
0	500	37.60	7.52	70
20	500	51.00	10.20	56.67
40	500	60.00	12.00	40
60	500	50.00	10.00	36.67
80	500	53.00	10.60	26.67

Table 3 Treatment of Deglet Noor using Blanching with Brine Solution i.e (NaCl)

Temperature level ℃	Weight of Sample Before Sun drying (g)	Weight of Sample After Sun drying (g)	Moisture content of the Sample (%)	Infestation Level (%)
0	500	52.0	10.40	46.67
20	500	55.0	11.00	33.33
40	500	45.0	9.00	16.67
60	500	56.0	11.20	13.33
80	500	51.0	10.20	6.67

Table 4 Treatment of Medjool using Blanching with Plain Water

Blanching Temperature ℃	Weight of Sample Before Sun drying (g)	Weight of Sample After Sun drying (g)	Moisture content of the Sample (%)	Infestation Level (%)
0	500	15.90	3.14	60.00
20	500	21.00	4.20	36.67
40	500	21.20	4.24	23.33
60	500	23.50	4.70	26.67
80	500	26.50	5.30	16.67

Table 5 Treatment of Medjool using Blanching with Brine Solution (NaCl)

Blanching Temperature ℃	Weight of Sample Before Sun drying (g)	Weight of Sample After Sun drying (g)	Moisture content of the Sample (%)	Infestation Level (%)
0	500	21.00	4.20	40
20	500	19.10	3.82	30
40	500	18.50	3.70	13.33
60	500	21.00	4.20	13.33
80	500	22.00	4.40	10

IV. CONCLUSION

This research showed that blanching temperature and drying has significant effect on physical properties of date palm fruit varieties as well as on moth infestation of stored date palm. The optimum pretreatment combination for two date palm fruit varieties were found to be 80 ^{o}C blanching temperatures at 12 minutes blanching time which yielded 4.40% moisture content and 10% infestation rate for 22.00g dried medjool variety. Deglet Noor variety yielded 10.20% moisture content and 6.67% infestation rate at treatment combination of 80 ^{o}C blanching temperature and 12 minutes blanching time. The findings of this of this research work will promote processing, preservation and storage of Date Palm Fruit (*Phoenix Dectylifera*) for future consumption. It is therefore expected that this research will motivate farmers responsible for production and perhaps the consumers to carry out pre-treatment on drying and storage of Date palm fruit to avoid infestation of moths and other micro-organisms inside the Date as well as to slow down the enzymic activities during storage.

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